RS - INT
SILVICULTURE
Harvest Cuttings

February 2, 1942

HARVEST CUTTINGS IN PONDEROSA PINE

1. Field division: Forest management research

2. Work project: Silviculture

3. Line project: Harvest cuttings

4. Purpose: To determine the best methods of cutting ponderosa pine from the standpoints of reserve stand growth, natural regeneration, sustained yield, and watershed protection.

5. Review of past work: The principal line of work has been the measurement of actual results of various methods of cutting on permanent sample plots established for this purpose. Information on growth, mortality, reproduction, and logging damage has been derived and reported for a total of 23 plots on the Payette, Boise, and Salmon National Forests, some of them dating back to 1913. Similar data on an extensive scale were provided by a survey of five selectively cut areas in central Idaho. Experimental cuttings were made on the Boise Basin Experimental Forest in 1933. None has been made since. It is planned to further develop this experimental forest as a testing and demonstration area. Six periodic surveys (1935-40) of the experimental forest have been made to determine mortality from bark-beetle attack -- a question of major importance in this type.

6. Accomplishments during past year: Nine permanent sample plots in virgin forests and four in selectively cut stands were remeasured to determine growth, mortality, and reproduction changes; partial data being compiled. Compilation of extensive cut-over study continued.

7. Plans for next year: Finish report on extensive cut-over area study. Compile remeasurement data. Check transects. Annual bark-beetle survey. Plan and supervise experimental cuttings.

8. Date of completion: Indefinite

9. Assignment: E. L. Mowat

RS - INT
SILVICULTURE
Stand Improvement

February 2, 1942

STAND IMPROVEMENT OF PONDEROSA PINE

1. Field Division: Forest management research

2. Work project: Silviculture

3. Line project: Stand improvement

4. Purpose: To evolve and test methods of stand improvement which are silviculturally and economically feasible in the ponderosa pine type.

5. Review of past work: In 1934, 25 plots representing five degrees of thinning were established in sapling and pole stands. To date these have indicated that snow damage in the first two winters following treatment is heavy but not serious. Demonstration areas established in 30- to 60-year-old stands have indicated that crop tree thinnings will yield up to 11 cords of fuel wood per acre, leaving a residual stand of over 100 trees including 40 to 50 choice well-spaced crop trees. Pruning studies to date have indicated the type of tool suitable to use and the type of tree economical to prune. Yearly removal of dead and dying trees on the experimental forest has supplied the village of Idaho City with a substantial portion of its fuelwood needs, and has served also as a sanitation and fire hazard reduction measure.

6. Accomplishments during past year: None, suspended.

7. Plans for next year: Completion of analyses on past studies. Report preparation. Remeasure three permanent sample plots, and check pruning scars in rate-of-healing study.

8. Date of completion: Indefinite.

9. Assignment: E. L. Mowat and C. S. Schopmeyer

RS - INT
SILVICULTURE
Silvics

February 2, 1942

SILVICS OF PONDEROSA PINE

1. Field division: Forest management research

2. Work project: Silviculture

3. Line project: Silvics

4. Purpose: To determine the factors and conditions affecting natural reproduction including: (1) seed supply and distribution, (2) physical and biotic factors pertaining to germination and seedling establishment, and (3) factors pertaining to subsequent survival and growth; and the time of seasonal growth and other phenological events as related to climatic data, for use in other investigations and in forest management.

5. Review of past work: Regeneration factors: Cone crop records of 1,500 trees on permanent sample plots for 7 years and seed trap studies have given useful data on seed production and distribution, showing adequate base supply in good seed years. During 1936-39 factors affecting germination, establishment, and growth were measured on a series of seeded plots in exclosures on north, south, and flat sites. Extensive transect studies (in addition to those on Mc plots) in 1935 and 1937 showed relations of soil, aspect, cover, etc., to establishment and first-year mortality of natural seedlings. Study in 1938-41 showed plant competition has little effect on germination, but greatly increases mortality and reduces size and vigor of seedlings. Phenology: Weekly measurements of current height and diameter growth of local tree species have been made through growing seasons of 1936-40 on the Boise Basin Experimental Forest. Phenological notes and growth measurements have been made on key species of grasses, herbs, and shrubs.

6. Accomplishments during past year: Continuation of regeneration study revealed (1) exceptionally heavy seed crop in 1940, with average dissemination of 324,000 seeds per acre on cut-over areas, (2) effective seeding to a distance of 70 feet from source on burned areas, and (3) largest crop of natural seedlings ever recorded on Boise Basin Experimental Forest with 6,700 seedlings per acre on cut-over areas, of which 80 percent were alive at the end of the season. Phenology study was suspended.

7. Plans for next year: Regeneration: Seed supply measurements to be continued. Transects and competition plots to be checked for survival of 1941 seedlings. Compilation and analysis preparatory to major report. Phenology: Field work discontinued. Analyze data, correlate with weather records, and report when time permits.

8. Date of completion: Regeneration factors: Mostly by 1943, with minor phases on to 1944 or beyond. Phenology: Indefinite.

9. Assignment: E. L. Mowat.

RS - INT
REGENERATION
Planting

February 2, 1942

FIELD PLANTING AND SEEDING OF PONDEROSA PINE

1. Field division: Forest management research

2. Work project: Regeneration

3. Line project: Planting

4. Purpose: To develop planting and seeding techniques and criteria of site selection which will insure successful regeneration of burned-over and otherwise denuded timber lands in the Intermountain region through study of (1) the factors of site and of source, size, age, and treatment of stock, and (2) the methods of planting and seeding responsible for good and poor survival and growth.

5. Review of past work: Exploratory studies in planting and seeding since 1934 have indicated that use of husky stock having good balance between top and root volume and care in handling and in site preparation, including reduction in competition, are advantageous in planting; and that artificial protection of seeds and reduction of competition have proved distinctly beneficial in seeding. Experimental nursery studies have indicated desirable seedbed protection, water schedule, and thinning practices. Studies of root systems of planted and natural seedlings have pointed the need for a better understanding of root physiology in relation to pruning, lifting, and planting practices. Seed studies have furnished a reliable seed maturity index, and indicated desirable collection and storage practices.

6. Accomplishments during past year: In contrast to preceding years, the summer of 1941 was relatively moist and cool, with the result that both spring plantings and seedings showed the best survival yet obtained in the study areas (92 percent in date-of-planting series). Loss heavy from winter kill after fall planting. Favorable weather obscured usual aspect differences and advantages of early planting. Advantage of careful technique and spot preparation again demonstrated. Direct seeding with screen protection yielded 85 percent survival compared to 50 percent for transplants on same plots. Several office reports prepared.

7. Plans for next year: Make spring plantings in season and date tests. Initiate new tests of direct seeding and site preparation. Examine active plots per schedule. Prepare reports on past studies.

8. Date of completion: Indefinite.

9. Assignment: E. L. Mowat and C. S. Schopmeyer.

RR - INT
MANAGEMENT
Utilization Standards

February 2, 1942

RANGE UTILIZATION STUDIES

1. Field division: Range research

2. Work project: Grazing management

3. Line project: Utilization standards

4. Purpose: Determination of standards of satisfactory utilization on western ranges, including: proper degree of use of forage species under various soil and site conditions; means of measuring degree of utilization for different classes of range forage; and suitable criteria for judging range use.

5. Review of past work: Findings by Sampson and others led to the general acceptance of 75 to 90 percent current utilization of the more palatable forage species as proper degree of use on most range types. Forsling and Storm found that on oak-brush range these standards needed to be modified somewhat to meet variations in plant cover. Also such standards proved to be too high for steep slopes and coarse soil types. More conservative use came generally to be advocated, but methods of estimating utilization were not uniform and the actual use allowed was so variable that modified standards often were not achieved. Studies on methods of estimating utilization and the effect of grazing upon plant growth in subsequent years were initiated at the Great Basin in 1938. Intermountain Utilization Standards Handbook was issued in 1939.

6. Accomplishments during past year: Volume-height tables were found not to be entirely practical as a means for determining utilization. In 1938 the accumulated volume of Kentucky bluegrass at 2-inch height was 74, 58, and 82 percent, respectively, for the oakbrush, aspen-fir, and spruce-fir zones. Corresponding values in 1941 were 71, 59, and 48 percent, a difference of 34 percent for the spruce-fir zone.

   Observations on changes in seasonal moisture and chemical constituents of range plants fail to explain preferences shown by livestock. Except for red elderberry, neither dry matter nor crude protein percentages for species grazed season long varied markedly from species grazed seasonally. Crude protein content of 16 important range forage species averaged 25.2 percent on June 18, thus approximating that of feed concentrates. On September 19 the average was only 9.3 percent, a value comparable with low-grade roughages.

7. Plans for next year: (1) Continue series of plants set out for studying effects of varying degrees of use upon subsequent yield and other plant responses. (2) Cooperate with AAA in 1942 range program. (3) Prepare manuscripts of all studies now completed.

8. Date of completion: Indefinite.

9. Assignment: Ira Clark

RR - INT
MANAGEMENT
Summer Range

February 2, 1942

SUMMER RANGE STUDIES

1. Field division: Range research

2. Work project: Grazing management

3. Line project: Summer range

4. Purpose: To ascertain range management practices that will permit wisest use of Intermountain summer ranges.

5. Review of past work: Early development of grazing plans based on plant succession and development are reported in USDA Bul. 791 (1919) and 1405 (1926). Technical Bulletin 686 (1939) is a refinement of phases of Bul. 791 and 1405 and shows that grazing periods and plant development for the different altitudinal zones can be predicted with a fair degree of accuracy on the basis of the date snow is off. Preliminary aspects of the germination of seed of certain important range species are reported in the Botanical Gazette 98:243-269, 1936. The essential climate of the mountainous region is characterized in the Monthly Weather Review 65:291-301, 1937. Recent analysis of old quadrats and major plots show that there are extensive areas in the Hudsonian zone that in the last 15 years have changed from a weed to a grass type, while in contrast there are other areas that have remained virtually static.

6. Accomplishments during past year: A study of the micro-climate and utilization of species on extensive sheep ranges reveals that the static condition relative to vegetative change in certain log-and-block enclosures and the contrasting shift from broadleaf herbs to grass on adjacent grazed areas is probably largely attributable to grazing preference of sheep for broadleaf herbs. Investigations of the gopher activity on a typical weed-grass type shows, on the basis of 1941 data, that approximately 5 tons per acre of subsurface soil are thrown upon the land surface and that the influence of the activity on plant succession is of great importance. Paired seedling transects distributed in comparable vegetated and open areas substantially corroborate findings suggested from old quadrats that new species become established in masses of existing vegetation rather than in open interstices.

7. Plans for next year: Continue studies to ascertain more exactly effects of grazing, gopher activity, seed dispersal, and seeding establishment on the sum total of successional trends.

8. Date of completion: Indefinite

9. Assignment: Lincoln Ellison

RR - INT
MANAGEMENT
Spring-Fall

February 2, 1942

SPRING-FALL RANGE STUDIES

1. Field division: Range research

2. Work project: Grazing management

3. Line project: Spring-fall ranges: methods of managing foothill spring-fall ranges in the mountainous regions of the West.

4. Purpose: To determine for sagebrush-grass spring-fall ranges the effect of different methods of grazing management, and different seasons and intensities of grazing upon individual plant species, sustained animal and forage production, and the soil resource.

5. Review of past work: Investigations begun in 1923 indicate rotation management is essential on spring-fall ranges. The grazing capacity of sagebrush-grass range when used equally in spring and fall under a rotation system appears to be from 1 to 1/3 sheep month per acre for range in good condition and 1/4 to 1/2 sheep month per acre for poor range. Lighter rates of stocking obscure effects of grazing systems on range cover and livestock.

   Recovery of deteriorated range is slow owing to sagebrush competition. Removal of sagebrush by fire followed by good management on areas having a good grass understory resulted in a 150-percent increase in forage production within 4 years. From 10 to 20 years of proper management is required to obtain a comparable increase when sagebrush is not removed.

   Perennial grasses may require more than five favorable years to recover from 1 to 2 years of severe drought damage.

6. Accomplishments during past year: Utilization of good sagebrush-grass range cannot be satisfactorily estimated from the utilization of one or two key species. Compilation of the completed phase of grazing studies indicates that at least 4 to 6 plant species, each chosen for its ability to represent a group of plants that bear close relationship to it in utilization, are needed.

7. Plans for next year: Suspend pasture grazing studies pending analysis of past results as basis for renewal on proper level of grazing intensity. Continue plant development, protection plots, and observations on burned areas.

8. Date of completion: Indefinite

9. Assignment: Joseph F. Pechanec and George Stewart

RR - INT
MANAGEMENT
Winter Range

February 2, 1942

WINTER RANGE STUDIES

1. Field division: Range research

2. Work project: Grazing management

3. Line project: Winter ranges

4. Purpose: To develop range management methods which will permit the rehabilitation of denuded areas, maintain forage productivity, and promote the best use of winter ranges.

5. Review of past work: In 5 years of managed grazing at Desert Station, plant cover has increased 50 to 70 percent, plant vigor 4 to 7 times, and herbage yields fourfold. Properly grazed areas showed approximately the same increase in vigor as those totally protected. Under proper grazing and protection the best forage species such as Indian ricegrass, black sage, and winterfat increased, Russian-thistle almost disappeared. Seedling production was almost equal, but survival was many times greater on properly grazed and protected areas than on heavily grazed range.

   Sheep body weights changed an average of -2.40, +2.41, and +2.02 pounds per head, respectively, on heavily, moderately, and lightly grazed range during the fall; -3.64, +2.45, and +1.72 pounds per head during winter; and +3.47, +7.41, and +5.27 pounds per head in spring. Ewes wintered on conservatively grazed range were maintained in 10 to 12 pounds more flesh, produced about 1 pound more wool, and from 50 to 75 cents more profit per head than sheep on heavily grazed range.

6. Accomplishments during past year: Abundant precipitation stimulated increased forage production on all grazing areas at the Desert Station, but forage yield on properly grazed range was 4 to 5 times greater than on heavily grazed areas. On big sagebrush range in northwestern Nevada heavily grazed areas produce only 15 to 100 pounds of grass herbage per acre. Desirable grasses are 10 to 20 times more abundant on areas from which both livestock and rabbits are excluded. Rabbits completely utilized all grass in areas from which livestock were excluded, indicating need for considering rabbit population in estimating grazing capacities.

7. Plans for next year: Continue studies on range management at Desert Range Branch Station and on Nevada enclosures.

8. Date of completion: Indefinite.

9. Assignment: Selar S. Hutchings and George Stewart.

RR - INT
ARTIFICIAL REVEGETATION
Site Factors

February 2, 1942

SITE FACTOR STUDIES

1. Field division: Range research

2. Work project: Artificial revegetation

3. Line project: Site factors: soils, climate, altitude, and other factors in relation to growth requirements of species used in artificial revegetation.

4. Purpose: To determine the effect of site factors on the growth and ultimate forage production of species used in artificial revegetation.

5. Review of past work: Competition for soil moisture from established dominants such as Artemisia tridentata and Bromus tectorum is a frequent cause of failure of plantings made in these vegetative types. Failure of artificial reseeding has been found to be attributable also to delayed germination and retarded root development due to cold temperatures and deficient precipitation. Germination of several important species has been increased from 5 percent under standard temperatures to more than 80 percent by cold treatment. A similar increase in germination of other species has been effected by scarification.

6. Accomplishments during past year: Initiated a field study to extend laboratory tests of seed treatment for improving germination. In an initial test, shrub cuttings which were rooted successfully in the greenhouse by treatment with indole-acetic acid failed to survive in the field. In a competition study, roots of sagebrush were found to have made active growth in summer while those of fall-planted perennial grasses and cheatgrass grew rapidly in fall and spring. Further studies of competition were initiated to determine survival of reseeded grasses on cleared ground and in stands of sagebrush, with and without root-pruning the latter.

7. Plans for next year: Continue seed pretreatment studies and sagebrush competition tests including correlation of sagebrush survival with wind movement, evaporation, and soil moisture.

8. Date of completion: Indefinite

9. Assignment: Joseph H. Robertson, C. Kenneth Pearse, and A. Perry Plummer.

RR - INT
ARTIFICIAL REVEGETATION
Methods

February 2, 1942

ARTIFICIAL REVEGETATION METHODS

1. Field division: Range research

2. Work project: Artificial revegetation

3. Line project: Methods: time, depth, culture, practicability, and cost of planting.

4. Purpose: To determine the most practical time and methods of planting and subsequent treatment in the revegetation of depleted ranges.

5. Review of past work: Tests show most effective seeding can be accomplished by fall sowing with a drill on brush- and rock-free sites, by disking and harrowing on loose soils and by furrowing and ripping on compact or rocky soils where weed competition must be reduced. Covering seed by trampling and broadcasting on snow are unreliable. Mixtures of seed are more satisfactory than single species.

6. Accomplishment during past year: Several large-scale reseeding trials employing selected mixtures and effective methods produced good seed crop and forage in one year. An effective log drag for covering seed in timber, weedy openings, and brushlands was used in connection with new study in aspen zone. Previous reseeding failures, apparently due to competition in ecologically closed communities, indicates necessity for reducing competition on reseeding areas.

7. Plans for next year: Tests of methods which will reduce competition will be continued on Bromus tectorum areas and initiated on Madia glomerata sites. Records will be continued on going tests. Prepare comprehensive analysis of reseeding costs and benefits.

8. Date of completion: Indefinite

9. Assignment: C. Kenneth Pearse, A. C. Hull, Jr., and Joseph H. Robertson.

RR - INT
ARTIFICIAL REVEGETATION
Plant Breeding

February 2, 1942

SELECTION AND HYBRIDIZATION STUDIES

1. Field division: Range research

2. Work project: Artificial revegetation

3. Line project: Plant breeding: selection and hybridization (conducted in cooperation with the Bureau of Plant Industry and the Utah State Agricultural Experiment Station, the Bureau of Plant Industry acting as leader and prosecuting the detailed work).

4. Purpose: To produce improved strains of range plants by selection. To determine the pollen production and quality, and pollination and seeding habits of range plants as a basis for hybridization studies; and to produce improved strains of range plants by hybridization.

5. Review of past work: Several strains of eight species commonly used in range reseeding were planted at several localities in 1939 and 1940. Seed from species showing notable variation were collected and planted near Ogden for further observation. Mass selection strains of Bromus inermis and Agropyron smithii were planted on a dry-land nursery. Self-pollinization of Bromus inermis was initiated to obtain homozygous material for hybridization studies.

6. Accomplishments during past year: Field-adaptability tests were initiated on several sites in Utah using stabilized strains of Agropyron cristatum, A. smithii, Bromus inermis, Dactylis glomerata, Festuca elatior, F. rubra, Phleum pratense, and Poa pratensis. An extremely large form of Agropyron spicatum growing near Paradise Valley, Nevada was found to have 28 somatic chromosomes. Because the possibility of hybridization is unlikely, it appears that this plant may be a tetraploidal form. Another study to determine inherent variation in native range species was initiated.

7. Plans for next year: Routine observations will be continued on all selection and strains tested in the nurseries. Investigation as to the quality of the plants produced by self-pollinating Bromus inermis will be continued. Hybridization studies will be initiated as soon as the essential materials are available.

8. Date of completion: Indefinite.

9. Assignment: Wesley Keller, Bureau of Plant Industry; C. Kenneth Pearse, Advisory, Forest Service.

RR - INT
ARTIFICIAL REVEGETATION
Species Adaptability

February 2, 1942

SPECIES ADAPTABILITY STUDIES

1. Field division: Range research

2. Work project: Artificial revegetation

3. Line project: Suitability of plant species for artificial revegetation.

4. Purpose: To determine which forage species, whether native, introduced, or produced by plant breeding, are best adapted to the various problem areas of the Intermountain region.

5. Review of past work: Since 1936 seed from 300 species has been planted on weed-free dryland nurseries at eight climatologically different locations in the region. In 1940 tentative recommendations were compiled on adaptability of 25 species which had survived tests simulating range conditions; five most promising species were planted for seed production.

6. Accomplishments during past year: In the species seed production study, Agropyron subsecundum and Elymus glaucus in their first year produced the relatively large yields of 110 and 135 pounds per acre of seed, respectively. Eight additional nursery and field tested species were planted to extend the seed production test. Six species (Agropyron dasystachyum, A. trichophorum, Bromus pumpellianus, Elymus canadensis, Hordeum bulbosum, and Stipa columbiana) appear to be adapted after preliminary nursery trials and were seeded under field conditions for further testing. Further tests also were initiated to determine causes of failure of some species in preliminary nursery trials. A palatability test of several reseeded species was initiated on a grazed range.

7. Plans for next year: Continue nursery trials and field checks of promising species and seed production tests. Determine herbage yields of species surviving field tests and initiate controlled grazing tests on reseeded areas.

8. Date of completion: Indefinite

9. Assignment: A. Perry Plummer, George Stewart, A. C. Hull, Jr., and Richard M. Hurd.

RE - INT
RANGE ECONOMICS
Area Studies

February 2, 1942

AREA STUDIES IN RANGE ECONOMICS

1. Field division: Forest economics

2. Work project: Range economics

3. Line project: Range economics

4. Purpose: To analyze the relationship of Federal ranges to the agricultural economy of the Intermountain region in order to determine the best use and distribution of national forest grazing.

5. Review of past work: Region-wide range resource study initiated in 1939 showed (a) 97 percent of region is range, forest, or wasteland, with 74 percent publicly owned, and (b) national forest grazing use reduced 33 percent for range-watershed protection during period 1924-38.

   Central Utah area study initiated in 1939 showed (a) 97 percent of range livestock dependent on public range, (b) small operators representing two-thirds of national forest permittees secure only one-fifth of national forest use, whereas about 10 percent of sheep operators secure 50 percent of national forest range use.

6. Accomplishments during past year: Region-wide study completed in graphic summary form showing wide variations in size of range livestock operations, dependency upon public range and size of permits, indicating need for detailed studies on specific areas to work out selective system for adjusting national forest permits.

   Central Utah study completed to rough draft report stage showing that essential reductions in national forest grazing use can be achieved without serious economic disturbance through selective cuts among both large and small permittees who have alternative opportunities for useful employment of labor and facilities.

7. Plans for next year: Publish region-wide and central Utah area study reports and initiate southern Idaho study.

8. Date of completion: Southern Idaho area study, 1 to 2 years.

9. Assignment: M. H. Saunderson and Arthur H. Roth, Jr.

RI - INT
STREAMFLOW
Woodland Cover

February 2, 1942

STREAMFLOW ON WOODLAND RANGES

1. Field division: Forest and range influences

2. Work project: Influences of natural vegetation on streamflow

3. Line project: Woodland cover

4. Purpose: To determine for watersheds with woodland (mixed tree, shrub, and grass) cover along the steep, mountainous Wasatch Front, the management practices that will assure the most valuable yield of streamflow.

5. Review of past work: In the Great Basin about 80 percent of streamflow originates largely from melted snow on summer range lands above 7,000 feet elevation. Spring run-off amounts to 65 to 90 percent of the total annual yield. South-facing watersheds yield more uniform seasonal flow than north-facing watersheds, apparently because of a longer period of recharge. Only small quantities of water reach channels by overland flow because infiltration rates are greatly in excess of snow melting rates.

   Factors that produce floods and mud-rock flows in summer from these same watersheds are barren "islands" having low infiltration rates, limited restraints to surface run-off, and high intensity storms. Some watersheds having high run-off potential are natural, others have been induced by destructive use.

   The Wasatch Streamflow Laboratory, comprising six north-facing and five south-facing watersheds, has been established near Farmington, Utah to study relationship of streamflow phenomena to watershed management practices. Plant and soil inventories have been made and streamflow and climatic control established on each watershed. The yield of water with respect to elevation on two watersheds of 1,377 and 2,025 acres, respectively, and cooperative artificial ground water recharge studies are also being carried on.

6. Accomplishments during past year: Twenty-one stream gaging stations and all established climatic control stations were operated, approaches to ten Venturi-trapezoidal flumes were completed, and field calibration was made of these flumes as a check against laboratory calibration made in 1936 and 1937. Completed field measurements of elevation study.

7. Plans for next year: Operate all stream gaging stations on schedule, maintain minimum climatic control, supervise small WPA compilation crew, submit proposal to State WPA to completely man this project.

8. Date of completion: Artificial recharge of ground water, field phase, 1942; balance, indefinite.

9. Assignment: B. C. Goodell and A. R. Croft

RI - INT
STREAMFLOW
Grassland

February 2, 1942

STREAMFLOW ON HERBACEOUS RANGE, WASATCH PLATEAU

1. Field division: Forest and range influences

2. Work project: Influence of natural vegetation on streamflow

3. Line project: Grassland

4. Purpose: To determine for watersheds with herbaceous cover on the Wasatch Plateau, the relationship of streamflow phenomena to grazing management practices and to upstream engineering practices.

5. Review of past work: The 10-acre A-B watersheds during the period 1916-29 revealed 95 percent of run-off is derived from melting snow while 85 percent of destructive silt is carried away by run-off from summer storms. Reduced intensity of grazing and an increase in plant cover density from 16 to 40 percent resulted in reducing overland flow about 75 percent. The experimental design for the A-B areas was revised in 1934. In 1940 permanent V-type, rubble masonry stream gaging stations were established on the following tributaries: Ephraim Creek, 13,000 acres; Right Fork Ephraim Creek, 1,645 acres; four small watersheds in upper Right Fork of 45 to 374 acres; upper Left Fork, 221 acres. Climatic control consists of 1 physical factor station and 18 standard rain gages. Plant and soil inventory data have been assembled from records of RI and FI studies within the experimental area. A topographic map of the upper small watersheds comprising 1,866 acres has been made.

6. Accomplishments during past year: During the snow melting period from April 1 to June 15 a detailed study was made of streamflow characteristics in relation to weather conditions, snow melting and infiltration rates, and overland flow. Field rating data were obtained on all newly installed stream gaging stations. The Ephraim Creek station was operated yearlong, all others from April to December 1.

7. Plans for next year: Report snow melting streamflow study. Maintain operating schedule on stream gaging and climatic control stations. Make tentative plan of treatment to be applied after period of calibration.

8. Date of completion: Report on snow melting study, 1942; watershed studies, indefinite.

9. Assignment: A. R. Croft, Richard B. Marston.

RI - INT
STREAMFLOW
Grassland

February 2, 1942

STREAMFLOW ON BUNCHGRASS-GRANITIC SOIL RANGES, IDAHO

1. Field division: Forest and range influences

2. Work project: Influences of natural vegetation on streamflow

3. Line project: Grassland: Role of grassland in influencing stream behavior.

4. Purpose: To determine for bunchgrass-granitic soil range lands of southern Idaho, the management practices required for obtaining plant and soil conditions that will yield maximum quantities of usable streamflow.

5. Review of past work: The quantity of undesirable silt-laden surface run-off on the Boise River watershed was found to increase with deterioration of the range cover, soil disturbance, decreased organic matter content of the soil, increased rainfall intensity, and increased slope steepness. Infiltration measurements show that true flood source areas occur as restricted spots within all range cover types on which infiltration capacities are about one-half the rates on areas in good condition. In 1935, two 10-acre watersheds and in 1937 three 200-acre watersheds were equipped with stream gaging stations.

6. Accomplishments during past year: Maintained climatological and streamflow records to November 10.

7. Plans for next year: Suspend.

8. Date of completion: Study suspended.

9. Assignment: George W. Craddock and _____

RI - INT
WATER UTILIZATION
Range Forage

February 2, 1942

WATER UTILIZATION BY BUNCHGRASS-GRANITIC SOIL RANGES, IDAHO

1. Field division: Forest and range influences

2. Work project: Water utilization by vegetation

3. Line project: Range forage. Relation of water requirements of range forage species.

4. Purpose: To determine on the unchgrass-granitic soil range lands of southern Idaho the kind f cover required for minimum evapotranspiration water losses.

5. Review of past work: Battery of six 2-milacre lysimeters constructed at Bannock Creek in 1933. Filled with untamped, homogeneous soil in 1935. In 1937 two tanks each planted to climax, subclimax, and annual weeds. Average annual water loss during 1936-41 was 12.08 inches or about 50 percent of annual precipitation. All water yields occurred in spring, 99 percent being seepage flow. Soil moisture study at Arrowrock substation during 1940 showed soil moisture content decreased to below wilting coefficient from surface to 30-inch depth on both improved and deteriorated range.

6. Accomplishments during past year: Continued soil moisture study at Arrowrock substation, extending samples to 6-foot depths, and maintained lysimeters at Bannock Creek.

7. Plans for next year: Complete report on soil moisture study; suspend other.

8. Date of completion: Indefinite.

9. Assignment: George W. Craddock and _____

RI - INT
WATER UTILIZATION
Woodland Cover

February 2, 1942

WATER UTILIZATION BY WOODLAND, SHRUB, AND HERBACEOUS COVER

1. Field project: Forest and range influences

2. Work project: Water utilization by vegetation

3. Line project: Water utilization by woodland cover

4. Purpose: To determine evapo-transpiration losses of woodland cover representative of the steep Wasatch Front in Utah.

5. Review of past work: Increasing demands for water in the Intermountain region have focused attention on water losses by consumptive use of riparian and watershed vegetation and on methods of reducing these losses. A survey has been made of methods through which the consumptive use of water by plants *in situ* could be determined. The plan adopted consists of seasonal soil moisture studies involving determination of (1) soil moisture content in the root zone when leafing begins, (2) soil moisture recharge during the growing season, (3) soil moisture balance when leaves drop. The method requires a rapid means of soil moisture determination. Laboratory tests have been made of tensiometers and electrical conductivity methods. Conductivity and weight measurements of plaster-of-Paris-clay blocks (equal parts) gave reliable results throughout the complete range of capillary soil moisture.

6. Accomplishments during the past year: Field installations were made in woodland and in shrub species using plaster-of-Paris-clay blocks. Placement of the blocks throughout the root zone was made possible by soil moisture sampling pits constructed in 1940 in woodland, browse, and herbaceous cover. Calibration of blocks on a weight basis was started in woodland and shrub cover installations.

7. Plans for next year: Complete block calibration and maintain routine measurements of present installations.

8. Date of completion: Report on field soil moisture block calibration, 1942. Consumptive use phases, indefinite.

9. Assignment: A. R. Croft, James Thorne

RI - INT
SOIL STABILIZATION
Watersheds

February 2, 1942

SOIL STABILIZATION ON HERBACEOUS RANGE, WASATCH PLATEAU

1. Field division: Forest and range influences

2. Work project: Soil stabilization

3. Line project: Watersheds

4. Purpose: To determine for watersheds with herbaceous cover on the Wasatch Plateau, management practices necessary to maintain soil stability.

5. Review of past work: Increase in plant cover density, from 16 to 40 percent on watersheds A and B, reduced soil erosion 54 percent. On these areas more than 85 percent of soil eroded was by summer rains which constitute only about 4 percent of the total precipitation. Severe soil erosion losses in summer are associated also with decreased infiltration rates caused by trampling and changes in the physical structure of the soil. Approximately 80 percent of Ephraim Canyon, a 13,000-acre watershed, has been affected by accelerated soil erosion. Organic matter, total nitrogen, and moisture equivalent in the surface inch of soil (watershed average) is only 55 percent of that in uneroded soil (geologic normal). Informal cooperative field studies with R.O. indicate need for reliable criteria to determine proper soil and grass management relationships, and for judging accelerated erosion. To more adequately study these relationships, three 1/10-acre run-off plots have been installed in the oakbrush and in the spruce-fir zones, respectively. Soil sampling plots have been established on all experimental areas. Soil samples have been secured and analyzed for organic matter, total nitrogen, and moisture equivalent as a basis for measuring soil changes resulting from different grazing practices.

6. Accomplishments during past year: Participated with R.O, in examining grazing allotments in Utah and Idaho for purposes of correlating soil management and forage management practices. Routine soil erosion measurements were made on areas A and B, oak-sage, and bluebell plots.

7. Plans for next year: Continue R.O. cooperative study and establish tentative criteria for correlation of proper soil management and forage management practices. Continue plot and watershed studies.

8. Date of completion: Soil stability criteria study, 1942; other, indefinite.

9. Assignment: A. R. Croft, Richard B. Marston.

RI - INT
SOIL STABILIZATION
Watersheds

February 2, 1942

SOIL STABILIZATION ON WOODLAND, BRUSH, AND HERBACEOUS RANGES

1. Field division: Forest and range influences

2. Work project: Soil stabilization

3. Line project: Watersheds

4. Purpose: To determine on the mixed woodland, shrub, and herbaceous ranges of the Wasatch Front, the management practices necessary for the maintenance of soil stability and usable streamflow.

5. Review of past work: Measurements were made of accelerated soil erosion on 2,000 plots along 175 miles of transects in 21 localities. Measured changes in important physical and chemical soil properties reveal losses of 70, 39, and 67 percent, respectively, in organic matter content, total nitrogen, and moisture equivalent. Even moderate erosion reduced these properties 43, 24, and 39 percent,, respectively. On three watersheds, on which the degree of grazing since settlement is known, indices of soil normality are 65 for light grazing, 54 for moderate grazing, and 49 for severe grazing as compared to a possible index of approximately 90.

   Correlation coefficients between organic matter and total nitrogen ($r = 0.982$) and organic matter and moisture equivalent ($r = 0.915$) are so high that measurement of organic matter loss is considered a reliable index of changes in the other two properties.

   Preliminary studies indicate that trampling, per se, by grazing animals is an important factor contributing to the loss of soil when torrential storms occur, and to decreased (about 50 percent) infiltration rates.

   Soil samples have been secured from 2,000 plots on 11 watersheds at Wasatch Branch Station, comprising 1,935 acres, and from 16 surface run-off plots as a basis for determining future soil trends. All samples have been analyzed for one or more of the following: physical properties, organic matter, total nitrogen, moisture equivalent, and hydrogen ion concentration.

6. Accomplishments during past year: Progress was made in the analysis of soils data from six north-facing watersheds, comprising 781 acres.

7. Plans for next year: Continue analysis of field and laboratory data; formulate tentative criteria to guide soil and plant management practices.

8. Date of completion: Analysis of present field data, probably 1942. Phases involving grazing effects, indefinite.

9. Assignment: A. R. Croft and B. C. Goodell

RI - INT
SOIL STABILIZATION
Watersheds

February 2, 1942

SOIL STABILIZATION ON BUNCHGRASS-GRANITIC SOIL RANGES, IDAHO

1. Field division: Forest and range influences

2. Work project: Stabilization of soils

3. Line project: Watersheds: Relation of forest, brush, grassland cover, and management practices to erosion and soil stability, and to quality and usability of water.

4. Purpose: To determine on bunchgrass-granitic soil ranges of southern Idaho the range utilization practices required for maintaining soils in place and the improvement measures needed to stabilize soil on eroding areas.

5. Review of past work: Widespread accelerated erosion on the Boise River watershed has been found to be directly related to deterioration of the range cover, soil disturbance, rainfall intensity, and slope steepness. In 1935 two 10-acre watersheds at Bannock Creek were equipped to measure erosion. In 1937 three 200-acre watersheds were equipped to measure run-off, but facilities were not installed to measure erosion, as intended. In 1937 erosion was measured from deteriorated range plots by means of a rainmaker with a view toward remeasurements after plots are improved by artificial reseeding.

6. Accomplishments during past year: Maintained erosion tanks on A-B watersheds.

7. Plans for next year: Study suspended.

8. Date of completion: Indefinite

9. Assignment: George W. Craddock and _____

RI - INT
FLOOD CONTROL
Watershed Survey

February 2, 1942

PRELIMINARY EXAMINATION REPORTS

1. Field division: Flood control surveys

2. Work project: Flood control surveys

3. Line project: Preliminary examinations: Examination of watersheds to determine existence of flood problems.

4. Purpose: To determine the existence of flood problems and the need for and character and cost of a detailed flood control survey on watersheds.

5. Review of past work: Participated in Public Hearings in cooperation with U. S. Engineer Corps on watersheds of the Snake River, Lahontan Lake, Bonneville Lake, and Colorado River drainage basins.

6. Accomplishments during past year: Submitted PE report upon the Wasatch Front Watershed in Utah, and participated in preparation of a report upon the Weiser River Watershed, Idaho, in cooperation with the Bureau of Agricultural Economics.

7. Plans for next year: Indefinite

8. Date of completion: Indefinite

9. Assignment: George W. Craddock

RI - INT
FLOOD CONTROL
Watershed Surveys

February 2, 1942

WATERSHED SURVEYS ON SEVIER LAKE AND WASATCH FRONT

1. Field division: Flood control surveys

2. Work project: Flood control surveys

3. Line project: Watershed surveys: Detailed surveys of approved watersheds for preparing action program.

4. Purpose: To determine the kind, cost, and benefits of measures needed to be applied for flood control, waterflow retardations, and soil erosion prevention on watershed lands.

5. Review of past work: Submitted report on Boise River Watershed in 1940 and initiated survey on the Sevier Lake Watershed, Utah.

6. Accomplishments during past year: Completed field work on Sevier Survey and submitted survey work outline for survey on Wasatch Front Watershed.

7. Plans for next year: Complete Sevier Survey report and continue with Wasatch Front Survey.

8. Date of completion: Indefinite

9. Assignment: George W. Craddock

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION

PUBLICATIONS

I. Publications during the calendar year 1941

A. Departmental publications

Bailey, Reed W. Climate and settlement of the arid region. USDA Yearbook, pp. 188-196, 1941.

B. Outside publications (in scientific and professional journals, etc.)

Bailey, Reed W. Mountain floods and vegetation. Proc. 6th Pac. Sci. Cong. 1939. IV: 731-736. 1941.

_____ Land erosion -- normal and accelerated -- in the semi-arid West. Trans. Amer. Geo. Union, pp. 241-250, 1941.

Ellison, Lincoln. Notes on ecology of subalpine range plants in central Utah. Utah Acad. Sci., Arts and Letters Proc., 18: 12, 1941.

Goodell, Bertram C., and Roberts, Kenneth L. Test of snow-sampling tubes of large and small diameter. Amer. Geo. Union Proc., 1941.

Hull, A. C. Jr. Competition between sagebrush and reseeded species on a burned-over area in southeastern Idaho. Utah Acad. Sci., Arts and Letters Proc., 18: 12, 1941.

Pearse, C. Kenneth. Range grass seed: A promising crop for Utah. Utah Farmer, 61(5): 9, 1941.

Pechanec, Joseph F. Sampling error in range surveys of sagebrush-grass vegetation. Jour. Forestry 39(1):52-54, 1941.

_____ Range problems of the sagebrush-grass type. The Utah Juniper, 12: 4-7, 1941.

_____ and Stewart, George. Sagebrush-grass range sampling studies: variability of native vegetation and sampling error. Amer. Soc. Agron. Jour., 33(12):1057-1071, 1941.

Saunderson, M. H. A basis for taxation of grazing lands. Natl. Wool Grower, 31(6), 1941.

_____ The economics of western range land conservation. Mont. Acad. Sci. Proc. 1941.

Stewart, George. Historic records bearing on agricultural and grazing ecology in Utah. Jour. Forestry, 39:362-375, 1941.

_____ Aridity and civilization. Utah Acad. Sci., Arts and Letters Proc. 18: 13, 1941.

& _____ Development of irrigation as a collective enterprise. Utah Acad. Sci., Arts and Letters Proc. 18: 4, 1941.

Thorne, James P. Physical and chemical characteristics of two mature soil profiles from Cache Valley, Utah. Western Society of Soil Science, Abstracts of Papers, p. 1, 1941.

C. Miscellaneous mimeographed reports

Pechanec, Joseph F. Application of analysis of covariance to range research data. Intermountain Forest and Range Experiment Station Technical Note No. 1, 21 pp., 1941.

Roth, Arthur H., Jr. A graphic summary of grazing on the public lands of the Intermountain region. Part II, Seasonal use relationships of lands used in the production of range livestock. 126 pp., June 15, 1941.

II. Manuscripts intended for departmental publication between January 1, 1942 and June 30, 1942.

Croft, A. R. The effect of soil profile characteristics on infiltration rates. Western Interstate Snow-Survey Conference Proc.

_____ and Goodell, Bertram C. Streamflow on the Wasatch Front in relation to elevation and aspect. Amer. Geo. Union Trans.

_____ and Marston, Richard B. The effect of foreign matter on the rate of snow melting. Western Interstate Snow-Survey Conference Proc.

_____, Woodward, Lowell, and Anderson, Dean A. Measurement of accelerated erosion on range lands. Jour. Forestry.

Ellison, Lincoln. A comparison of methods of quadrating shortgrass vegetation. Jour. Agr. Res. 20 pp., 6 illus.

Roth, Arthur H. Jr. A graphic summary of grazing on the public lands of the Intermountain region. Part III, Present use of the public land grazing resources by size and type of livestock enterprises. 83 pp. (Mimeographed)

_____ and Saunderson, M. H. A study of agricultural problems related to the administration of the Fishlake and Manti National Forests with alternatives for adjustment. USDA Tech. Bul., 50 pp., illus.

_____ and Saunderson, M. H. Methodology for use in range economic studies on western national forest areas. 25 pp. (Mimeographed)

July 1, 1942 and June 30, 1943

Clark, Ira. Seasonal changes in moisture content chemical constituents and livestock preferences for range plants. Jour. Agr. Res. 10 pp.

Clark, Ira and ..... Range use indications and utilization standards for Intermountain range lands. USDA Farmers' Bul., 25 pp., illus.

_____and ..... Plant vigor in relation to past grazing use. USDA Tech. Bul., 16 pp., illus.

Hutchings, Selar S. Palatability and utilization of desert vegetation as influenced by climate, season of use, and composition of plant cover. Jour. Agr. Res., 20 pp., illus.

Maki, T. Ewald. Collection, extraction, and testing of ponderosa pine seed. USDA Tech. Bul., 45 pp., 10 illus.

Mowat, Edwin L. Seed production by various sizes and classes of ponderosa pine trees in Idaho. Jour. Agr. Res., 12 pp., 5 illus.

Pechanec, Joseph F. Palatability and utilization of spring-fall sagebrush-grass range vegetation. Jour. Agr. Res., 15 pp., illus.

Plummer, A. Perry and Pearse, C. Kenneth. Methods of increasing the germination of seed of Oryzopsis hymenoides. Jour. Agr. Res., 10 pp., illus.

Robertson, Joseph H. Relation of method of seedbed preparation to mortality of reseeded seedlings.

Stewart, George and Hutchings, Selar S. Improvement of winter granges as influenced by season of use and intensity of grazing. USDA Tech. Bul., 32 pp., illus.

_____, Pechanec, Joseph F., and Pickford, G. D. Effect of sagebrush removal by fire on native spring-fall range in southeastern Idaho. USDA Tech. Bul., 30 pp., 12 illus.

III. Manuscripts and articles proposed for outside publication.

Bailey, Reed W. Mud-rock flows, Wasatch Mountains. Amer. Jour. Sci.

_____ Slope development. Jour. Geomorph.

_____ Mountain-valley relationship in the semiarid West. Geog. Rev.

Clark, Ira. Suitability of volume-height tables for estimating the degree of range forage utilization. Jour. Forestry, 12 pp., illus.

Ellison, Lincoln. A visual method of ecological analysis. Ecology. (Note)

_____ A quantitative study of competition. Ecology.

_____ Some ecological relations for recreation areas. Ecology.

Harris, J. A., and Stewart, George. Plant sap properties and their relation to environmental conditions. Ecology.

Hull, A. C., Jr. Hand machines facilitate collection and cleaning seeds of range forage species. Note for Jour. Forestry.

_____ and Pechanec, Joseph F. An extension of range for blue grama. Ecology.

Hurd, Richard M. and Clark, Ira. Comparative palatability of grasses used in range reseeding. Amer. Soc. Agron. Jour.

Hutchings, Selar S. A new method of coordinate mapping of low shrubs. 6 pp. Amer. Soc. Agron. Jour.

_____ Management phases of hauling water to sheep and cattle on winter ranges and economic returns obtained. 6 pp., Natl. Wool Grower.

Maki, T. Ewald. Branching habit and rate of natural pruning in second growth ponderosa pine. Jour. Forestry.

_____ and Mowat, Edwin L. Some physical and chemical characteristics of granitic soils in central Idaho. Soil Sci.

_____ The relation of snow storage to plant cover and other factors within the ponderosa pine type. Jour. Forestry.

Mowat, Edwin L. Results of selective cutting in ponderosa pine forests of central Idaho. Jour. Forestry (or mimeographed).

Pearse, C. Kenneth, and Hull, A. C. Jr. The economic aspects of range reseeding. Jour. Forestry.

_____ Range reseeding — is it economically sound? Amer. Cattle Prod.

Plummer, A. Perry. Viability, rate of germination, and early development of 12 important range grasses. Amer. Soc. Agron. Jour.

Robertson, Joseph H. Seasonal development of roots of sagebrush. Ecology.

_____ and Weaver, [illegible]. Lloyd. A new tetraploid wheatgrass from Nevada. Torrey Bot. Club Bul.

Saunderson, M. H. The western beef cattle production and marketing situation in relation to range management in the western United States. Amer. Cattle Prod.

_____ Idaho national forests and the range sheep industry of southern Idaho. Idaho Forester.

Schopmeyer, Clifford S. Factors effecting survival and growth of planted ponderosa pine in central Idaho. Jour. Forestry.

Stewart, George, and Hull, A. C., Jr. Grass reseeding on mountainous summer ranges of the Intermountain region. Amer. Soc. Agron. Jour.

_____ and others. Forest production as related to livestock management in northeastern Nevada. To be published by Nevada Agricultural Experiment Station.

_____ and Clark, Ira. Influence on spring pasturing and hay meadows on yield and quality of hay harvested. Amer. Soc. Agron. Jour., 10 pp.

University of Idaho and Intermountain Forest and Range Experiment Station.* Variations in the chemical composition of arrowleaf balsamroot. Amer. Soc. Agron. Jour., 12 pp., illus.

University of Idaho and Intermountain Forest and Range Experiment Station. Influence of climate and stage of maturity on the chemical composition of bluebunch wheatgrass. Proc. Amer. Soc. Animal Prod., 12 pp., illus.

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* Cooperative papers. Pechanec, Joseph F. and Stewart, George will represent the Intermountain Station. The University of Idaho will designate men to represent their part of the publication.